DOCUMENT RESUME

ED 421 850 EC 306 623

TITLE	Integrating Technology into the Standard Curriculum.
INSTITUTION	ERIC Clearinghouse on Disabilities and Gifted Education, Reston, VA.
SPONS AGENCY	Special Education Programs (ED/OSERS), Washington, DC.
PUB DATE	1998-00-00
NOTE	9p.
CONTRACT	RR93002005
AVAILABLE FROM	ERIC/OSEP Special Project, ERIC Clearinghouse on Disabilities and Gifted Education, The Council for Exceptional Children, 1920 Association Dr., Reston, VA 20191-1589; telephone: 703-620-3660; TTY: 703-264-9449.
PUB TYPE	Collected Works - Serials (022) -- Guides - Non-Classroom (055)
JOURNAL CIT	Research Connections in Special Education; n3 Fall 1998
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Appropriate Technology; *Assistive Devices (for Disabled); *Computer Uses in Education; *Curriculum Design; *Disabilities; *Educational Technology; Elementary Secondary Education; Literacy; Mathematics Instruction; Preschool Education; Science Instruction; World Wide Web

ABSTRACT

This newsletter describes promising research in applying technology in the curriculum to improve learning opportunities for students with disabilities. Topics addressed include: (1) promoting access to early childhood curriculum; (2) considering assistive technology in the IEP; (3) using a web-based curriculum for elementary students with mild disabilities to enhance literacy learning, particularly writing; (4) improving access to the science curriculum using technology tools to help students develop understanding of scientific concepts and to ensure access to instructional activities; (5) improving concept development in mathematics; (6) supporting assistive technology at the state level; and (7) describing how technology supports Maine's state standards. Recommendations for integrating technology into the classroom are provided, including locating equipment where instruction and learning are taking place, selecting low tech applications whenever possible; integrating the use of technology into lessons in a purposeful and meaningful way, having the same equipment used in the classroom available in the child's home, offering training and technical support to classroom teachers initially, viewing the initial fiscal and human resources as an investment, and using the technology that is already in place when possible. (Contains 11 resources and a list of 8 resource contacts.) (CR)

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ED 421 850

Research Connections

in Special Education

This Issue

Number 3
Fall 1998

Federal law now requires that assistive technology be considered for every student with disabilities. Increasingly, technology is recommended to help students with cognitive disabilities achieve in a challenging curriculum. This issue describes promising research in applying technology in the curriculum to improve learning opportunities for students with disabilities.

Assistive technology is defined as any item, piece of equipment, or product, whether acquired commercially, off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of individuals with disabilities. (P.L. 101-407, The Technology Related Assistance Act of 1988)

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Development funded by U.S. Office of Special Education Programs

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Integrating Technology into the Standard Curriculum

Extending Learning Opportunities for Students with Disabilities

Current Federal laws require students with disabilities to have the greatest possible access to the general education curriculum in the least restrictive environment. According to **Judy Heumann**, Assistant Secretary, U.S. Department of Education, "Technology is an invaluable way to achieve access." In fact, the 1997 reauthorization of the **Individuals with Disabilities Education Act** (IDEA) emphasizes the importance of technology and the need to share cutting-edge information about advances in the field. The law requires that assistive technology (AT) devices and services be considered for all children identified as having an exceptional education need.

These amendments mark a significant shift in how educators view assistive technology—which previously had been viewed almost exclusively within a rehabilitative or remediative context. Now, within the context of developing individualized education plans (IEP), technology is being considered as a viable tool for expanding access to the general education curriculum. As such, assistive technology has been expanded to include what has been traditionally thought of as instructional technology.

Denice DeCoste, Director of Assistive Technology for the Montgomery County Schools in Maryland, concurs that IDEA '97 has caused a shift in how educators have expanded their thinking about assistive technology. "We are receiving an increased number of referrals for children with mild disabilities in which the issue is access to the curriculum **and** productivity once in the curriculum." School-based professionals like DeCoste are finding that the "fix-it" approach taken with traditional assistive technology applications is not appropriate for these new types of technology referrals.

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Integrating Technology Into the Standard Curriculum

> *"It is important to start with the curriculum and do a standard task analysis. From there, consider how low-tech devices can provide access to children before looking at more high-tech applications."*
>
> *Mother of 1st Grader, Elizabeth Garcia*

"More often than not, instructional issues require us to start with the curriculum and then ask how tools might assist students in achieving the outcomes."

Technology that supports students in accessing the curriculum does not need to be expensive or complicated to make a difference in learning. Both low tech and high tech applications have been used to ensure students' success in the general education curriculum.

How are educators meeting the challenge of the new law? How are educators expanding their use of technology to ensure access to the curriculum? In some cases, the shift is subtle. For example, let's take a look at an early childhood teacher in Montgomery County, Maryland, who found that the shift involved looking at the curriculum and determining how assistive technology could be a solution to integrating students into the classroom and connecting them to challenging learning goals.

Promoting Access to Early Childhood Curriculum

Teachers of young children in Montgomery County, Maryland, are finding that a little technology goes a long way in helping students achieve curriculum goals. Take, for example, **Robert Gitterman**, who is included full-time in **Jacqueline Daye**'s second grade classroom. "Technology use starts with instructional objectives—it is a tool for meeting curriculum goals," Robert's mother asserts.

To accommodate Robert, who is non-speaking and has fine motor, neurological difficulties, a word processor, printer, and AlphaSmart (a portable word processor produced by Intelligent Peripheral Devices) were provided. "I wanted the technology chosen for Robert to be integrated into the classroom so that he could fully participate in all learning activities," Daye tells us. Daye describes an example.

> Typically, we have children this age do a lot of drawing and illustrating—an activity that is very difficult for Robert. When it came time to illustrate a book report, we considered the instructional objectives. The activity was modified so that Robert could use clip art to illustrate his report. This creative use of technology allowed him to participate with his peers.

According to Robert's mother, it would be impossible for him to learn and share his knowledge in the classroom without the use of a word processor and printer. "Robert's ability to think critically and learn higher level concepts dictated a more sophisticated tool than a simple, low tech communication device." Accordingly, Ms. Gitterman warns against using technology that is not matched to instruction. "There is a danger that AT will be too cumbersome to use...if it becomes too tedious or requires too much involvement by the child, AT can easily become an expensive problem." [see the sidebar for her suggestions]

> *"I don't want my children to miss out on the general education curriculum when they are with me, and so I am constantly developing technology applications."*
>
> *Patti Fredericks, Special Education Teacher*

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Considering Assistive Technology in the IEP

Assistive technology can be an important tool for improving teaching and learning results. But while the results appear promising, there is still much work to be done to ensure that IEP teams consider the maximum benefits of technology use.

"The new requirements in IDEA '97 to consider assistive technology devices and services for all students with disabilities creates a massive task for school districts," reports **Gayl Bowser**, Coordinator of the Oregon Technology Access Program and President-Elect of the Technology and Media Division of the Council for Exceptional Children. "School districts are searching for tools that they can use to ensure that IEP teams meet the intent and the spirit of the law."

As part of an OSEP-funded project, Bowser and her colleague **Penny Reed** developed the Education TECH Point system which can be used by school districts as a tool to develop effective assistive technology delivery systems. The TECH Point system offers educators a strategy for identifying specific points in the planning process where AT should be considered. The TECH Points are

- Initial referral question.
- Evaluation questions.
- Extended assessment questions.
- Plan development questions.
- Implementation questions.
- Periodic review questions.

At each point, questions are posed that reflect issues that must be addressed. Bowser points out that the TECH Point structure "provides a way to effectively organize and monitor AT utilization while enabling programs to tailor activities to match each student's needs."

IDEA also mandates that each student with an individualized transition plan must have AT considered as part of his or her required services. With OSEP funding, Bowser and her colleagues are expanding their work into the area of planning for transition. "There are certain issues—such as self determination—that make consideration of AT at this stage unique. For example, individuals should be involved in selecting their own technology, and should be provided technology that they can use independently."

When Considering Technology

- Locate equipment where instruction and learning are taking place. Technology needs to be in the classroom and accessible to the child.
- Select low tech applications whenever possible.
- Integrate the use of technology into lessons in a purposeful and meaningful way.
- Have the same equipment used in the classroom available in the child's home to promote continuity of learning, if possible.
- Offer training and technical support to classroom teachers initially. When the technology is available in the home, provide training to family members.
- View the initial fiscal and human resources as an investment that the child will continue to benefit from in subsequent years.
- Don't reinvent the wheel each year—when possible use the technology that is already in place.

Summary

The potential of technology to improve and enhance the lives of individuals with disabilities is virtually unlimited. Progress in recent years has demonstrated the need for intensified support to facilitate technological development and innovation into the 21st century. In the next section, we spotlight several researchers who have studied the positive benefits of using technology in academic subject areas.

Check Out These Resources

The ERIC Clearinghouse on Disabilities and Gifted Education has several digests and bibliographies related to AT.

Assistive technology for students with mild disabilities. ERIC Digest E529. Behrmann, M. (January 1995).

Readings on the use of technology for individuals with disabilities. ERIC Mini-Bib EB16. (July 1996)

Resources on the use of technology for individuals with disabilities. ERIC Selective Bibliography EB17. (July 1996)

Integrating Technology Into the Standard Curriculum: Promising Practices

The U.S. Department of Education Office of Special Education Programs (OSEP) has a long history—spanning nearly three decades—of supporting research and development related to assistive technology. From supporting research that produced closed captioned television and the Kurzweil reading machines in the early years, to research that brought us eye-gaze technology and chemistry laboratory instruments in the 1980s, to research that is using virtual reality applications to help children navigate wheelchairs in the present, OSEP has been an innovator in validating tools that increase independence, enhance individualized instruction, and support teachers in ensuring students' success.

Technology as a tool for meeting curriculum goals is an important area of focus for OSEP, and one that is showing great promise. Researchers are exploring how students can use technology to act on information and thereby learn. As such, technology is emerging as a cognitive tool or "partner," that supports the learning process.

The following research-based applications have been selected to show how technology is being integrated into curriculum and instruction to support a wide range of student abilities.

> *"When combined with appropriate instruction, technology can turn struggling students into successful students."*
>
> *Lynne Anderson-Inman, University of Oregon*

Enhancing Literacy Goals

How can a web site enhance literacy? Ask students from **Mary Lou Krausey**'s resource room at Post Oak Elementary School in Lansing, Michigan, and they will tell you the following:

- "I liked using computers to write personal stories."
- "You could learn how to read and write by writing on chatroom."

Students in Krausey's class were part of an OSEP-funded research study being conducted by Michigan State University researcher, **Carol Sue Englert**. "We have developed and are now evaluating a web-based curriculum for elementary students with mild disabilities that enhances literacy learning, particularly writing."

The web site called TELE-Web (which stands for Technology-Enhanced Learning Environments on the Web), serves as a literacy development environment. It offers teachers and students a set of integrated, multifunctional tools, consisting of server-side software and client-side plug-ins that work with a web server and database applications. It enables teachers to adopt, develop, manage, and share multimedia literacy materials, as well as to initiate, conduct and manage collaborative learning projects. Students' reading and writing responses also can be archived.

"Within the web site environment, students explore, experiment, and experience independently and collaboratively with their peers from the same school or from a school afar," Englert describes. "We have also included tools that help students develop performance abilities in reading and writing, in addition to the metacognitive skills related to becoming goal-oriented, self-regulatory, independent learners."

TELE-Web in the Classroom

Englert set up TELE-Web in Krausey's classroom as four central environments—writing room, reading room, library, and publishing room. Each environment has teacher and student interfaces which allows

- Teachers and students to create assignments.
- Students to create, revise, and complete assignments.
- Teachers and students to add on or to comment on other students' work.
- Students to read other students' stories.

"In each environment, students are able to receive cognitive and social support," Krausey tells us. "TELE-Web supports instruction by building in opportunities for discourse—which is an important instructional medium for helping students develop understanding of concepts." She offers the following examples of how TELE-Web was integrated into a unit on castles.

- ***TELE-Writing Room.*** A KWL (what I know, want to know, have learned about) activity on castles; retelling stories in one's own words; creating cognitive webs; play and story writing.
- ***TELE-Reading Room.*** Castle spelling words; castle chat.
- ***TELE-Library.*** Internet search on castles; castle word-sort; email to people knowledgeable

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Integrating Technology into the Standard Curriculum: Promising Practices (continued)

> *"TELE-Web increases and enhances academic skills of students with special needs. What's more, because students teach others as they learn, they build self-confidence and self-esteem."*
>
> *Patricia A Rose, Principal, Post Oak Elementary School*

about castles in Poland and Scotland.

- ***TELE-Publishing Room.*** Stories for editing and comments; journal of castle life contrasts.

Englert and her colleagues are currently analyzing data from three classrooms where TELE-Web has been integrated. Preliminary analysis suggests that children are more motivated to write, and that they are writing longer and more descriptive stories.

Improving Access to the Science Curriculum

Judy Zorfass, Associate Center Director at Education Development Center, Inc., in Massachusetts, is finding that technology tools can be integrated into science curriculum and instruction to

- Help students develop understandings about important science concepts.
- Ensure access to instructional activities, allowing students to participate more fully as inquirers.
- Provide students with the tools they need to observe the world around them, gather data, document what they find, and communicate their findings to others.

Zorfass' OSEP-funded Project ASSIST (All Students in Supported Inquiry-Based Science with Technology) brings together teachers, science specialists, special educators, and technology specialists regularly to plan, act, and reflect upon technology and how to support student learning in inclusive classrooms. "One person cannot do this alone," Zorfass stresses. "Involving specialists in the curriculum planning allows them to bring their expertise to the teacher in a deeply contextualized and coordinated manner."

To support educators in talking about children's science learning, Zorfass and Project Director, **Lori DiGisi**, created an action/reflection process. The team cycles—and then re-cycles—through these phases:

- Plan activities.
- Implement instruction.
- Reflect on progress.

During the planning phase the classroom teacher and the specialists develop a lesson containing clear science learning goals. The lesson is related to science standards, includes modifications for students with disabilities, and is supported by technology where appropriate. Teams are encouraged to select a student with disabilities, along with two other children, as a focus for planning and reflection.

After the plan is completed, the teacher implements the lesson. Typically, some of the team members also participate. Their role is to closely observe the focus children and gather data on their responses to the lesson. Observers also interact with these children, questioning or probing them to explain their thinking. In some cases, team members try different teaching methods to see what works with a particular child. An important task for team members is recording what children say as they engage in an inquiry. Such information is of critical importance during the reflection phase.

The reflection phase occurs soon after the lesson. Each team member shares the data he or she has gathered regarding student learning. The teacher and the specialists describe, interpret, and reflect on the students' work as it relates to the criteria that have been set. According to DiGisi, "This conversation gives every member of the team feedback on how their suggestions worked within the context of the science lesson; but it also provides a time to generalize beyond the targeted students to the class as whole and to plan for the next action/reflection cycle."

School District Teams

Educators in Cambridge Public Schools, Massachusetts, have been piloting the ASSIST model. According to Zorfass, "Educators started with a strong standards-based curriculum, made a commitment to include students with disabilities, and supported the students with a variety of tools."

Special Needs Technologist **Alan Field**, who has been working with numerous ASSIST groups in Cambridge, Massachusetts, notes the

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Integrating Technology into the Standard Curriculum: Promising Practices (continued)

importance of starting with curriculum. "This is not a fix-it type of approach. With a grounding in curriculum and instruction, technology applications are much easier to integrate." This has been an important distinction for teachers, according to Field, who, he says, view their participation as "satisfying the needs of all students, rather than just using technology for technology's sake."

While data and analysis are yet forthcoming, project staff and practitioners are learning a great deal. "One thing is very clear—it definitely calls for someone to undertake a new role of curriculum/technology specialist," Field says. "Unlike traditional technology specialists who troubleshoot problems and help write technology plans, I actually work in classrooms with teachers to support and promote technology in the curriculum—something I could not do very well without a deep understanding of science."

Improving Concept Development in Mathematics

What do spreadsheets, French fries, and the odds of one's surviving on the Titanic have in common? Math, if you are in **Cindy Bush**'s junior high school class. With the help of an LCD panel, one classroom computer, and spreadsheet software, students who have a history of math failure are learning how to pose questions of mathematical data and analyze the results. "We start with real life problems that students are interested in—like the odds of surviving on each of the Titanic's cabin levels, or the odds of getting 16 French fries in a package rather than the standard 15 (and what that costs the restaurant)—and discover how math can help us find solutions," Bush explains.

Unlike traditional math story problem lessons where students read a problem in text and are expected to calculate answers, Bush takes the data from real-life problems and enters it into a spreadsheet program. No longer hampered by reading difficulties and laborious calculations, students begin manipulating the data and formulating answers—activities, Bush points out that, "typically are not thought possible for students with cognitive disabilities."

Bush has been working with researcher **John Woodward** of the University of Puget Sound in Washington. With the support of OSEP and Microsoft Corporation, Woodward has been studying how technology can be integrated into mathematical problem solving activities to provide access to students with cognitive disabilities. "Essentially, technology enables us to engage students with disabilities in challenging curriculum—which is a major accomplishment given that many experts believe that students who do not possess basic math skills cannot learn higher level math skills."

Spreadsheets are an excellent tool because they model or provide visual representations of the problem, crunch the calculations (which Woodward points out is a tedious turn-off for many youngsters, but especially the case for students with disabilities), and thereby focus the students' attention on understanding the mathematical operations in a real-life context. "We are finding that spreadsheets free students who heretofore had difficulty with math to keep asking questions, to continue analyzing the visual representations of the data, and eventually to use their higher level thinking skills to formulate conclusions—kids are really thinking through what mathematical problem solving really means." One of Woodward's most promising findings is that when computer-generated visual representations are tied to concepts rather than to answers, the student's ability to think mathematically is enhanced.

You can find a selection of lessons on Woodward's website, at http://www.ups.edu/community/tofu/.

Research-Validated Practices

OSEP has conveyed information on research-validated practices through partnerships with associations and organizations. For example, with OSEP funding the Chesapeake Institute worked with the National Schools Board's Association to produce ***Technology for Students with Disabilities: A Decision-Maker's Resource Guide***. The guide contains current thinking on using technology to support learning, finding the right technology and paying for it, developing policies to support implementation, and locating resources. NSBA is at 703-838-6722.

State Initiatives Support Technology Use in the Curriculum

States have traditionally been concerned with identifying effective practices that improve educational results for children. With the 1997 Reauthorization of IDEA, and in many cases the implementation of statewide academic standards, states are beginning to explore how technology can help children meet their curriculum standards.

Supporting Assistive Technology at the State Level

To ensure that technology benefits children with disabilities, states need to implement policies and practices that support its effective use. "States are very busy meeting the challenges set forth in IDEA '97," **Martha J. Fields**, Executive Director of the National Association of State Directors of Special Education (NASDSE) tells us. "States are involved in a wide range of activities, including making professional development available, identifying multiple funding sources, disseminating information to local districts, and developing creative ways to ensure access to technology for children and their families."

Writing in *Counterpoint* (a publication of NASDSE), **Louis Danielson**, Director of the Division of Research to Practice at OSEP, suggested that state directors of special education also put into place a clear policy on assistive technology that includes:

- A statement of desired AT outcomes.
- Policies for delivering AT services.
- Staff development and technical assistance policies.
- Verification that the technology plan includes research-based practices.
- Mechanisms for interdisciplinary involvement.
- Policies for purchasing, using, and managing equipment.
- Strategies for obtaining adequate funding.
- Strategies for communicating these policies.

Technology Supports Maine Standards

In 1997, the Maine legislature passed a law requiring all students to achieve specific learning outcomes. In Maine, assistive technology is considered one of the supports for aiding access to the curriculum and other activities in traditional learning environments.

"Ideally, IEP teams should consider a full range of assistive technology devices and services that are available to address the developmental, instructional, and access needs of students," asserts **Kathleen Powers**, Director of the Maine Consumer Information Technology and Training Exchange (MaineCITE) Project in the Maine Department of Education. "The key to effective technology use is the technical skills and comfort level of teachers, parents, and administrators." The goal of MaineCITE Project is to build the capacity within the state for using technology to help children meet their IEP goals.

According to **Kathleen Fries**, Coordinator of the Project, it is a challenge to think about assistive technology as supporting achievement in the curriculum "First and foremost we must move beyond thinking of AT as a limited set of tools that solve a limited set of problems to seeing it as presenting an unlimited array of options and possibilities that can be applied to a multitude of situations." Such shifts in thinking have practical implications—for example, one of the most basic will be making assistive technology part of district planning and budgeting processes.

The Maine project is undertaking several efforts to support this shift in thinking. Examples include

- Identifying national models.
- Creating a cadre of in-state experts.
- Developing a network of professionals who have expertise using technology to support students with special needs.
- Collecting research and evaluation data that deepens knowledge about how technology is being used to enhance student results, preferred approaches to personnel preparation, and district policies that support technology use.
- Encouraging partnerships among school districts, parents, and higher education.

"By combining local creativity, knowledge, and expertise with the goal of high academic achievement for all students, we are able to share best practices around the state," reports Powers.

Assistive Technology Projects in 50 states and U.S. territories can provide more information on funding sources as well as other aspects of assistive technology. For information about whom to contact in your state, call RESNA at 703-524-6686.

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Research Connections *is a biannual review of research on topics in special education, focusing on research sponsored by the U.S. Office of Special Education Programs.*

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Developed by Warger, Eavy & Associates for the ERIC/OSEP Special Project. The ERIC/OSEP Special Project is operated by The Council for Exceptional Children through the ERIC Clearinghouse on Disabilities and Gifted Education. **Research Connections** *was prepared with funding from the U.S. Department of Education, Office of Special Education Programs, under contract no. RR93002005. It is in the public domain and may be freely reproduced and disseminated. The opinions expressed here do not necessarily reflect the positions or policies of OSEP or the Department of Education.*

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